

1        **CLAIMS**

2        1.     An animation rendering system, comprising:

3            a high-level animation subsystem that handles interaction functions for the  
4        system;

5            a low-level animation subsystem that handles display functions for the  
6        system;

7            at least one high-level clock that is referenced by high-level animation  
8        operations;

9            at least one low-level clock that is referenced by low-level animation  
10       operations;

11           a communications channel for sending messages between the high-level  
12       animation subsystem and the low-level animation subsystem according to a  
13       communications protocol; and

14           wherein the communications protocol includes information provided to the  
15       low-level animation subsystem by the high-level animation subsystem that  
16       designates an animation and specifies how the animation is to change over a  
17       specified period of time, thereby ensuring that the low-level animation system has  
18       information to process several frames of the animation.

1           2.    The animation rendering system as recited in claim 1, wherein the  
2 communications between the high-level animation subsystem and the low-level  
3 animation subsystem are asynchronous.

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5           3.    The animation rendering system as recited in claim 1, wherein:  
6           the low-level animation subsystem renders animations at a constant display  
7 frame refresh rate; and  
8           the high-level animation subsystem handles interactions at a variable rate  
9 that is slower than the constant display frame refresh rate.

1           4.     The animation rendering system as recited in claim 1, wherein the  
2 communication protocol further comprises at least one message sent from the low-  
3 level animation subsystem to the high-level animation subsystem to handle  
4 synchronization between the high-level animation subsystem and the low-level  
5 animation subsystem.

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7           5.     The animation rendering system as recited in claim 4, wherein one  
8 message sent from the low-level animation subsystem to the high-level animation  
9 subsystem further comprises a “synchronize with media slip” message that  
10 identifies a target clock associated with an animation and an amount that the target  
11 clock must slip to synchronize the high-level animation subsystem with the  
12 animation being run by the low-level animation subsystem.

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14           6.     The animation rendering system as recited in claim 1, wherein:  
15           the high-level animation subsystem further comprises a high-level timing  
16 engine;

17           the low-level animation subsystem further comprises a low-level timing  
18 engine; and

19           the communication protocol further comprises the following parameterized  
20 messages that are sent from the high-level timing engine to the low-level timing  
21 engine:

22                   a create clock message with initial clock properties parameter;

23                   an update properties message with a target clock parameter and an  
24 updated properties parameter;

1 an add interval message with a target clock parameter and an interval  
2 properties parameter;

3 a reset synchronization slip message with a target clock parameter;

4 a remove all intervals message with a target clock parameter; and

5 a delete clock message with a target clock to delete parameter.

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7 7. The animation rendering system as recited in claim 1, wherein:

8 the high-level animation subsystem further comprises a high-level  
9 animation objects database;

10 the low-level animation subsystem further comprises a low-level animation  
11 objects database; and

12 the communication protocol further comprises the following parameterized  
13 messages that are sent from the high-level animation objects database to the low-  
14 level animation objects database:

15 a create animation message with an output value type parameter, an  
16 animation function parameter and a controlling clock parameter;

17 an update animation message with a target animation parameter and  
18 an updated properties parameter;

19 a create animation collection message with a list of animations  
20 parameter;

21 an add animation to collection message with a target animation  
22 collection parameter and an animation to add parameter;

23 a remove animation to collection message with a target animation  
24 collection parameter and an animation to remove parameter;

1                   a create static value message with a value type parameter and an  
2 initial value parameter; and  
3                   an update static value parameter with a target static value object  
4 parameter and a new value parameter.  
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6           **8.**    A method for processing an animation application, comprising:  
7           receiving animation data from the animation application into a high-level  
8 animation subsystem;  
9           transmitting animation information from the high-level animation  
10 subsystem to a low-level animation subsystem according to a communication  
11 protocol over a communications channel so that the low-level animation  
12 subsystem can display an animation associated with the animation data;  
13           wherein the communication protocol provides for designating an animation  
14 and for instructions regarding how the animation should change over a particular  
15 time period so that the low-level animation subsystem can process several frames  
16 of the animation at a constant display frame refresh rate while the high-level  
17 animation subsystem executes at a variable refresh rate.  
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1        9.    The method as recited in claim 8, further comprising the high-level  
2 animation subsystem receiving at least one protocol message from the low-level  
3 animation subsystem to assist in keeping a timing element in the high-level  
4 animation subsystem synchronized with at least a timing element in the low-level  
5 animation subsystem.

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7        10.   The method as recited in claim 8, wherein the communication  
8 protocol includes the following messages that are sent from a high-level animation  
9 subsystem timing element to a low-level animation subsystem timing element:

10           a message to create a clock;  
11           a message to update clock properties;  
12           a message to add an interval to a clock;  
13           a message to remove all intervals for a clock; and  
14           a message to delete a clock.

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16        11.   The method as recited in claim 10, wherein the communication  
17 protocol further includes the following messages that are sent from a high-level  
18 animation subsystem timing element to a low-level animation subsystem timing  
19 element:

20           a message to reset a synchronization slip value in the low-level animation  
21 subsystem.

1           **12.**   The method as recited in claim 8, wherein the communication  
2 protocol includes the following messages that are sent from a high-level animation  
3 subsystem animation object element to a low-level animation subsystem animation  
4 object element:

- 5           a message to create an animation;
- 6           a message to update an animation;
- 7           a message to create an animation collection;
- 8           a message to add an animation to an animation collection; and
- 9           a message to remove an animation from an animation collection.

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11           **13.**   The method as recited in claim 8, wherein the communication  
12 protocol includes the following messages that are sent from a high-level animation  
13 subsystem animation object element to a low-level animation subsystem animation  
14 object element:

- 15           a message to create a static display value; and
- 16           a message to update a static display value.

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18           **14.**   A system, comprising:  
19           a high-level animation subsystem configured to receive animation  
20 information from an application;  
21           a low-level animation subsystem configured to render one or more  
22 animations according to the animation information;  
23           a low-level timing engine configured to monitor one or more low-level  
24 clocks in the low-level animation subsystem and to synchronize the low-level  
25 clocks with one or more high-level clocks;

1 a high-level timing engine configured to monitor one or more high-level  
2 clocks in the high-level animation subsystem according to one or more high-level  
3 animation objects and to transmit animation messages to the low-level timing  
4 engine, the animation messages conforming to a communication protocol; and

5 wherein the animation messages that are transmitted from the high-level  
6 timing engine to the low-level timing engine designate one or more animation  
7 objects and how the animation objects are to change over a specified period of  
8 time.

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10 15. The system as recited in claim 14, wherein the low-level timing  
11 engine synchronizes a low-level clock with a high-level clock by sending a  
12 “synchronize with media slip” message that identifies the high-level clock and an  
13 amount by which the high-level clock must slip to maintain synchronization with a  
14 low-level clock that corresponds to the high-level clock.



1           16.    The system as recited in claim 14, wherein the communication  
2 protocol further comprises the following messages:

3           a create clock message that identifies clock properties;

4           an update properties message that identifies updated clock properties;

5           an add interval message that adds a timing interval to clock properties;

6           a remove intervals message that removes timing intervals from clock  
7 properties; and

8           a delete clock message that deletes a clock.

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10           17.   The system as recited in claim 14, wherein the communication  
11 protocol further comprises the following messages:

12           a create animation message that creates an animation;

13           an update animation message that updates an existing animation;

14           a create animation collection that identifies multiple animations to be  
15 grouped;

16           an add animation to collection message that identifies an animation to add  
17 to an identified animation collection; and

18           a remove animation to collection message that identifies an animation to  
19 remove from an identified animation collection.

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21           18.   The system as recited in claim 14, wherein the communication  
22 protocol further comprises the following messages:

23           a create static value message that identifies a value type and an initial value  
24 to display; and  
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1 an update static value message that identifies a static value to update and a  
2 new value for the static value.

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4 **19.** The system as recited in claim 14, wherein the low-level timing  
5 engine is configured to send a synchronization message to the high-level timing  
6 engine according to the communication protocol that identifies a high-level clock  
7 and measure of how much the high-level clock should be altered to synchronize  
8 the high-level clock with a low-level clock.

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10 **20.** The system as recited in claim 14, further comprising:  
11 at least one low-level animation object;  
12 at least one high-level animation object configured to communicate with  
13 the low-level animation objects through communication protocol messages to  
14 create and update the low-level animation objects to reflect the high-level  
15 animation objects.

16  
17 **21.** A high-level animation subsystem in an animation rendering system,  
18 comprising:

19 one or more high-level clocks;  
20 a high-level timing engine configured to track the one or more high-level  
21 clocks;

22 one or more animation objects that identify at least a portion of an  
23 animation;

24 means for transmitting animation data to a low-level animation subsystem  
25 according to messages included in a communication protocol; and

1        wherein the communication protocol messages transmitted to the low-level  
2 animation subsystem identifies at least one of the animation objects in the low-  
3 level animation subsystem and provides data regarding how the identified  
4 animation objects are to change over a specified period of time.

1           **22.**     The high-level animation subsystem recited in claim 21, wherein the  
2 communication protocol further comprises the following messages:

3           a create clock message that identifies initial clock properties;  
4           an update properties message that identifies updated clock properties;  
5           an add interval message that identifies an interval to be added to a clock;  
6           a remove all intervals message that identifies a clock from which all  
7 intervals are to be removed; and  
8           a delete clock message that identifies a clock to be deleted.

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10           **23.**     The high-level animation subsystem recited in claim 21, wherein the  
11 communication protocol further comprises the following messages:

12           a create animation message that describes an animation to create; and  
13           an update animation message that identifies an animation to update and  
14 updated properties.

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16           **24.**     The high-level animation subsystem recited in claim 21, wherein the  
17 communication protocol further comprises the following messages:

18           a create animation collection message that identifies multiple animations  
19 that are to be grouped as one animation collection;  
20           an add animation to collection message that identifies an animation to be  
21 added to an identified animation collection; and  
22           a remove animation from collection message that identifies an animation to  
23 be removed from an identified animation collection.

1           **25.**     The high-level animation subsystem recited in claim 21, wherein the  
2 communication protocol further comprises the following messages:

3                 a create static value message that identifies a value type and an initial value  
4 to render; and

5                 an update static value message that identifies a static value to update and a  
6 new value for the static value.

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8           **26.**     A low-level animation subsystem in an animation rendering system,  
9 comprising:

10                 one or more low-level clocks;

11                 one or more low-level animation objects that identify at least a portion of  
12 an animation;

13                 a low-level timing engine configured to track the one or more low-level  
14 clocks with regard to the one or more low-level animation objects;

15                 wherein the low-level clocks and the low-level animation objects are  
16 created and updated through communication protocol messages received at a  
17 variable rate from a high-level animation subsystem in a manner that provides the  
18 low-level animation subsystem with several frames of animation data that can be  
19 displayed at a high, constant display frame refresh rate.